Test bench for the high voltage divider of the AMS Rich PMT

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LPSC report 03-03

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1. Introduction

The Ring imaging Cherenkov counter for the AMS experiment is under construction. 16-anodes PMTs (R7600-M16 model from Hamamatsu) equip the final counter. These PMTs modules consist of a High Voltage Divider (HVD) placed between the photomultiplier and the front end electronic. In this study, the base circuit is designed for a 850 power supply voltage with a 3mm per 1000V of dielectric isolation. The HVD integrity before the integration in the module PMTs.

2. Testing procedure

The printed circuit board of the HVD include a 80 MOhm divider.
The LPSC dedicated test bench operates as follows:

- The HVD is set to 1000Volts for 10 seconds and the current of this voltage divider is read and compared to the nominal current value.
- Each resistor is tested separately using different test probes located on the HVD socket
- The total resistance of the voltage divider is measured to complete the final measurement

The monitor verifies all the characteristics and gives the acceptance of each HVD tested.

3. Electronics test equipments

The testing board is a dedicated socket with multiple switches that feeds the high voltage and give the signal to the control measurement.
The electronic socket was designed at LPSC and developed in the electronic's group. It is made of delrin plastic by a digital manufacturer. The probes are placed on the socket and soldered on the board.

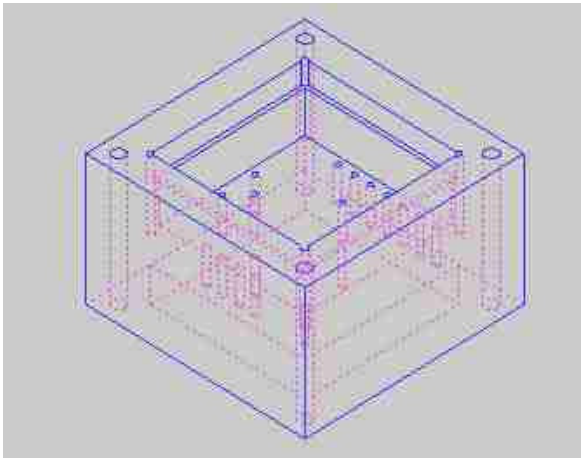

fig 1 : Socket of the HVD

This socket uses specific probes that receive each point of the high voltage divider circuit. These probes were chosen to perform the contact touch during the test.
They are divided in two parts:

- The body base soldered on the test card
- a probe is fixed to the receptacle with two sizes of plunger tip (the contact point) and applying a spring force to secure the best electrical contact.

We use a probe of IDI society sold in France by Cotelec. The probe reference is :

Piston SOE	SOE2.2G
Piston SOES	SOES2.2G
Receptacle RO	ROSC

Fig 2 : probe test point with its receptacle.

The test bench includes a PC computer equipped with a GPIB interface and a digital Input/Output board. The GPIB module coupled with a HP laboratory multimeter performed the measurement of the resistor selected by the switches. The high voltage power supply by CAEN associated with the RS232 links to the PC, provides the supply of 1000V and gives the consumed current measurement. The test bench is monitored by a program written with LabView from National Instrument.

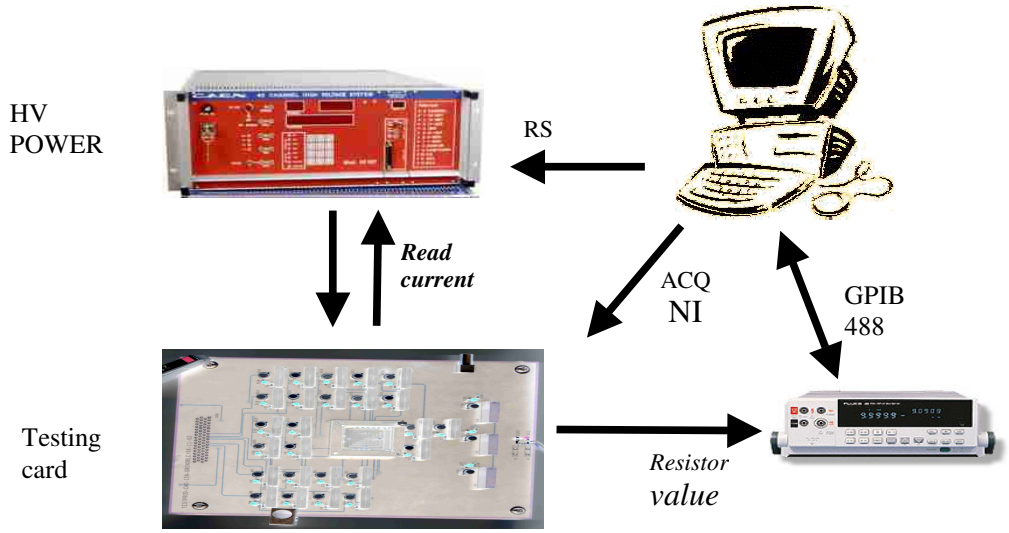

Fig 3 : test bench setup
Calibration The accuracy of the digital multimeter and the chain of reed relays in resistor calibration is 0.2 % in measurement of each resistor.

4. Software

The user interface allows to control all the test parameters below

- The level of the high voltage for the first test
- The read value of the current circuit under high voltage
- The amplitude variation of the resistance tolerance in the index
- A register with the name of the corresponding resistor is tested provide flags for the wrong measured values.
- A dialogue box indicates the success or failure of this test

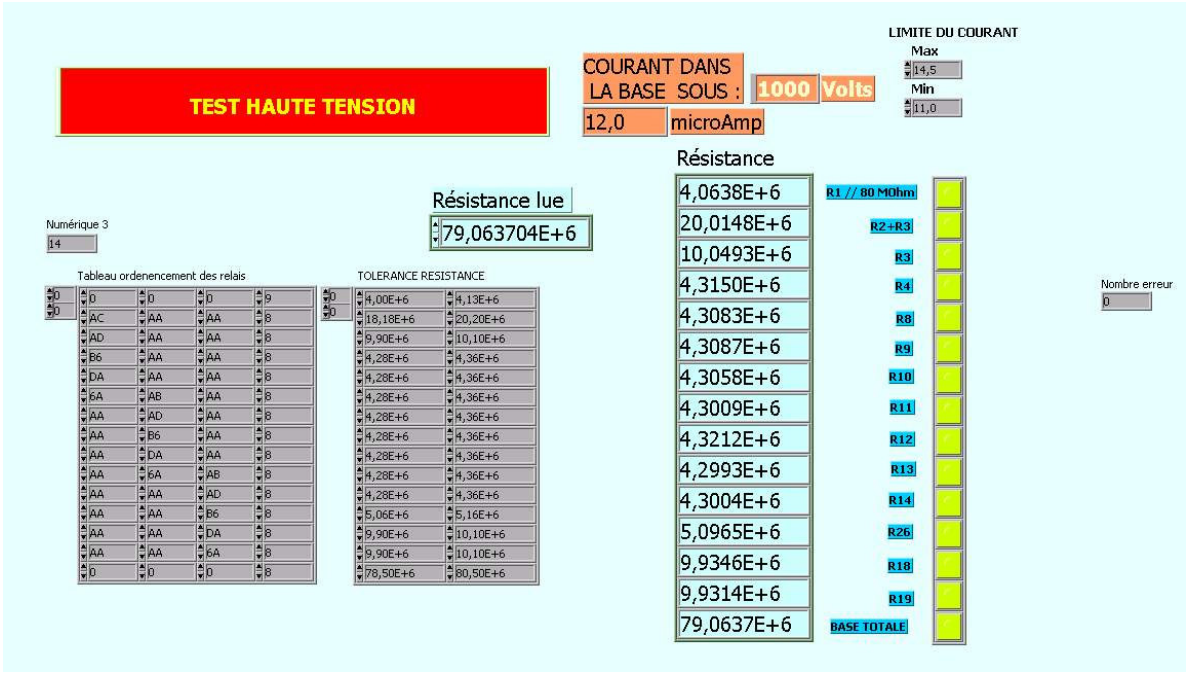

Fig 4 : General survey of the dialogue software

A LabView interface was used, by means of which dedicated Virtual Instruments (VI) were developed :

The VI “relais” controls the switch ordered by the digital I/O board, writing the word address corresponding to the position where the signal is forwarded through the testing card. All the position of the switch are stocked in an index.
The VI “Ohm” reads the value of the multimeter HP with the GPIB interface, it is compared to the calculate value in 1% of the nominal value.
The VI “accesVoie0+On” organizes the high voltage on the channel 0 and puts it on.
Afterwards, the consumed current of the circuit is read and compared to the nominal current value.
The VI “Off” makes sure that the high voltage power is off.
These last 2 Virtual Instruments use the RS232 link for the high voltage power.

5. Tests and results

The test bench developed at LPSC consists of a control of the high voltage divider circuit of the AMS Rich PMTs under construction. i.e. the step after cabling and before assembling with the analog electronics and PMTs.

This test bench performs in less than 1 minute the measurement of :

- The high voltage divider is powered with 1000 Volts (nominal value is 850V) for 10 seconds and its consumed current is measured
- Each resistor of the divider
- The total resistor of the voltage divider

The test bench was used for 3 days, during which 750 high voltage divider circuits were tested. Only 2 problems were observed. It appeared that some solderings were found missing on a resistor, and the value of one resistor was found to be at 4.7 MOhms instead of 10 MOhms.
Those cases could change the gain of the photomultiplier. They were corrected and retested before being validated for used in the construction.

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